

coal-yielding rock of the above localities are of Mesozoic age ; stating his reasons from the entire absence of Calamites and Lepidodendrons, and from the presence of Taenioptera, Phyllotheca, and other forms intimately related to those of the Mesozoic coal-beds of the oolitic formations of Yorkshire, Europe, Richmond (America), and India. That rocks of true Coal-measure age do occur in Australia there is no doubt ; we cannot here discuss the fragmentary and conflicting evidence of its presence and distribution until more reliable data has been collected.

Plate 10 illustrates two species of star-fishes from the Upper Silurian rocks, *Pteraster* and *Urasterella*, both of the family *Urasteridae*. McCoy's *Urasterella* is the *Stenaster* of Billings and *Palaeaster* of Hall ; and to this latter genus have been referred those forms of old star-fishes having adambulacral, ambulacral, and marginal plates on the arms, whereas *Urasterella* differs in only having one row of plates on each side of the ambulacral groove. The two forms figured in the decade are named after the present mining and late geological directors of the colony. *U. schwynii* appears to be the first fossil star-fish found in Australia. These star-fishes, like many other Australian fossils, are almost identical with our British types. We know of no more remarkable fact in the history and distribution of life than the affinity that seems to exist between the forms of life over two areas so old and so vastly removed as that of Britain and Australia, antipodal to each other ; universality might almost be applied through Homotaxis to the geographical distribution of the several formations which comprise the periods even stratigraphically and lithologically ; as well as the existence in common of numerous genera, and with many representative and some even identical species between the two countries. What difference in time there might have been between the deposition of the sedimentary materials and its accompanying life in our European or the American area, with that of the Australian region, we shall never know ; but the faunal relations were nearly the same, and the then species must have had a far wider distribution in space and time than we have hitherto imagined or generally believed.

This first Decade of Victorian Fossils will be studied with much interest by British palaeontologists, firstly on account of its being from the pen of the accomplished Director of the National Museum of Melbourne, and secondly on account of the valuable researches and matter forwarded to us illustrating the palaeontology or past life history of that remote region of the globe.

LIVINGSTONE'S "LAST JOURNALS"*

The *Last Journals of David Livingstone in Central Africa, from 1865 to his Death. Continued by a Narrative of his last moments and sufferings, obtained from his faithful servants, Chuma and Susi.* By Horace Waller, F.R.G.S., Rector of Twywell, Northampton. In two vols. With portrait, maps, and illustrations. (London : John Murray, 1874.)

THE Loangwa was crossed on December 15, and on Christmas Day Livingstone lost his four goats, a loss which he felt very keenly ; "for, whatever kind

of food we had, a little milk made all right, and I felt strong and well, but coarse food, hard of digestion, without it, was very trying." Indeed, after this Livingstone suffered much from scarcity of food, and became greatly emaciated and weakened ; and to intensely aggravate this, through the weakness of a boy and the knavery of a runaway slave, the medicine chest was stolen on January 20, 1867, a loss which was utterly irretrievable. "I felt," he sadly says, "as if I had now received the sentence of death, like poor Bishop Mackenzie." Fever came upon him shortly after, and for a time became his almost constant companion ; this, with the fearful dysentery and dreadful ulcers and other ailments which subsequently attacked him, and which he had no medicine to counteract, no doubt told fatally on even his iron frame, and made it in the end succumb to what he might otherwise have passed through with safety.

The Chambezi, whose course into Bangweolo Livingstone has finally determined, was crossed on January 28. While detained for about three weeks at the village of Chitapangwa, a somewhat able and on the whole well-meaning chief, he sent off a packet of letters and despatches with some Arab slaves ; these reached England in safety. He also sent forward a small supply of provisions to Ujiji. At last the southern shore of Tanganyika (or Lake Liemba, as the south part is called) was reached on March 31. By this time Livingstone was so weak, he could not walk without tottering. At the village of Chitimba, some distance west of the end of the lake, he was detained for upwards of three months, on account of a quarrel between a chief, Nsami, and the Arab Kamees, whom Livingstone found here with a slaving party, and who showed the traveller much kindness. On Aug. 30, difficulties having been adjusted, Livingstone proceeded westwards, and on Nov. 8 came upon the north end of Lake Mocro, "a lake of goodly size, flanked by ranges of mountains on the east and west. Its banks are of coarse sand, and slope gradually down to the water ; outside these banks stands a thick belt of tropical vegetation, in which fishermen build their huts. The country called Rua lies on the west, and is seen as a lofty range of dark mountains."

Proceeding southwards, Cazembe's, on Lake Mofwe, a lakelet a little south of Moero, was reached in a few days. The name of Cazembe is already known in connection with the journey, in the end of last century, of Dr. Lacerda, who died and was buried not far from the present village. This Cazembe (he was killed shortly after Livingstone's visit) was the tenth from the founder of the dynasty, who came from Lunda, and conquered the then reigning chief, usurping the chiefship. Cazembe treated Livingstone on the whole handsomely. The traveller remained at his village about a month, when he again went to the north of Lake Moero, and visited the Lualaba, the river which, rising in Lake Bangweolo as the Luapula, and of which the Chambezi may be considered the beginning, stretches away northwards and westwards through Lake Kamolondo, and again northwards, to what termination is not yet known. Livingstone had a firm belief that it was the upper part of the Nile, though appearances would seem to suggest that it more probably joins the Congo. There is every likelihood that Lieut.

* Continued from p. 145.

Cameron will be able ere long to solve the mystery. To this river Livingstone has given the name of his friend Webb, and to an important tributary from a reported large lake to the west, named by Livingstone Lake Lincoln, and made to join Lualuba about 3° S. lat., he has given the name of his staunch friend "Sir Paraffin Young." Livingstone again came south to Cazembe's in May 1868. Before this all but five of his men deserted to a slave party under Mohamed bin Saleh, who had been detained ten years at Cazembe's, and whom Livingstone helped to get off. He turned out an ungrateful cheat. Continuing southwards in June, Livingstone on July 18 reached Lake Bangweolo, although he was not really its first European discoverer, the Portuguese having been there long before him. With difficulty obtaining a canoe, he crossed to an island some miles off the north-west corner of the lake. The latter he calculates to be about 150 miles long by 80 broad, and is 3,688 feet above the sea. It, as well as Moero, abounds in fish of a great variety of kinds, some of which, no doubt, will ultimately be found new to science. Livingstone had no means of bringing away any specimens, and only gives the native names. As we have said, the north-east, east, and south sides of the lake are surrounded with "sponges," the water in many places being so deep as to require canoes, and is intersected by the courses of many streams. On islets in this sponge the villages are located.

In connection with this "sponge" and the rainy season, Livingstone enters in this part of his journal on a long disquisition on the climate of Central Africa, which we recommend to the notice of meteorologists. Speaking of the region around Bangweolo, he says "burns (*Scotia* for 'brooks') are literally innumerable: rising on ridges, they are undoubtedly the primary or ultimate sources of the Zambezi, Congo, and the Nile; by their union are formed streams of from thirty to eighty or one hundred yards broad, and always deep enough to require either canoes or bridges. These I propose to call the secondary sources, and as in the case of the Nile they are drawn off by three lines of drainage, they become the head waters (the *caput Nili*) of the river of Egypt." No one had a better right to theorise on this subject than Livingstone, for few had observed so much; but it may yet be found that he allowed his eagerness to settle the Nile question to run away with his cooler judgment.

After being detained near Bangweolo for some time by the disturbed state of the country, he proceeded northwards in the company of some Arab traders. Still further delay occurred to the north of Moero, caused by the barbarity of the Arab slavers with whom he was compelled to travel, and it was not till December that a start in earnest was made north-eastwards to Tanganyika. He became so ill on the road with pneumonia and other ailments, resulting from damp and a completely enfeebled constitution, that he became insensible and had to be carried part of the way. The effects of this illness never left him. The lake was reached in February 1869, and Livingstone entered Ujiji on March 14, a "ruckle of bones." Supplies had been forwarded to him here from Zanzibar, but his misfortunes were aggravated by finding that most of them had been knavishly made away with by those to whose care they had been entrusted.

The traveller re-crossed Tanganyika in July, and on August 2 set out on a new series of discoveries to the west of the lake, in a region not before visited, scarcely even by the Arabs, that of the Manyuema. Through this region flows into the Lualaba the large river Luamo, or Luasse, or Lobumba, rising close to the west shore of Tanganyika. Livingstone's object was to reach the Lualaba and if possible cross to the west side. After vainly trying to get west, he went into winter quarters in February 1870, at Mamohela, in about $4^{\circ} 20'$ S. lat. and $27^{\circ} 5'$ E. long. Another attempt was made to reach the river with only Chuma, Susi, and Gardner. He was again baffled and returned to Bambarre, south-west of Mamohela, in July, martyred with irritable eating ulcers in the feet, which seem to be caused by some form of malaria, and with which he was for long sorely troubled; he was confined to his hut for eighty days with them. During his long detention here, which galled Livingstone dreadfully, he records many observations of the people, who certainly seem to eat human flesh, and prefer it when very "high," but who were on the whole extremely kind to himself, notwithstanding the brutal usage given them by the Arab traders, with whom the country now swarmed, and who mercilessly burned villages and slaughtered men, women, and children, simply to inspire terror. Here Livingstone became acquainted with what Mr. Waller thinks is an entirely new species of chimpanzee, a remarkable animal called by the natives the "Soko," possessing wonderful intelligence and having some very curious habits. In February 1871, some men who proved worthless scoundrels reached him from the coast, and he again started for the Lualaba, which at last he reached on March 29. He stayed at a village, Nyangwe, for four months, vainly trying to get a canoe to take him to the other side, which was here 3,000 yards off, the bed of the river being dotted with many islands. This Nyangwe at which Livingstone stayed is a place of great interest; a regular market is kept daily to which hundreds of women from the other side flock to buy and sell goats, sheep, pigs, slaves, iron, grass cloth, salt fish, earthen pots, &c. The devilish treachery of the Arab slavers seems to have reached its height here during Livingstone's sojourn. A party under one Dugumbé, without warning or provocation, assembled one day when the thronged market was at its height, and commenced shooting down the poor women right and left, so that between those who were shot and those who were drowned, hundreds were killed, and the market completely broken up. No wonder that Livingstone had "the impression that he was in hell," and that his "first impulse was to pistol the murderers." This of course completely knocked on the head any chance which he may have had of getting a canoe, and in sickening disgust he made his way back to Ujiji, which he reached on October 23. While returning through Manyuema, his party was attacked by the enraged people, who mistook Livingstone for one of the slavers, and nearly stopped his further travels by a spear which grazed his back. This was the only time during these last seven years' wanderings that the traveller was hostilely attacked. Five days after his arrival at Ujiji he was cheered and inspired with new life, and completely set up again, as he said, by the timely arrival of Mr. H. M. Stanley, the richly-laden

almoner of the proprietor of the *New York Herald*. Mr. Stanley's story is known to everyone, and we need not repeat it.

With Stanley, Livingstone explored the north end of Lake Tanganyika, and proved conclusively that the Lusizi runs into and not out of it. It will be satisfactory if the discovery of an outlet on the west side, just announced in a despatch from Lieut. Cameron, turns out to be true. In the end of the year the two started eastward for Unyanyembe, where Stanley provided Livingstone with an ample supply of goods. Here Stanley urged his going home, but although he was now inwardly yearning to return, his judgment said, "All your friends will wish you to make a complete work of the exploration of the Nile before you retire." To this purport also was the advice of his daughter Agnes, whom he therefore calls "a chip of the old block." But had his judgment been cool enough, it might have told him that his constitution was so shattered that it was totally unequal to a task of such magnitude. The fountains he was in search of he supposed to be about 400 miles to the west of Lake Bangweolo.

The rest is soon told. Stanley left on March 15, and after Livingstone had wearily waited in Unyanyembe for five months, on August 15 a troop of fifty-seven men and boys arrived, some of the boys being Nassick pupils from Bombay, one of whom was Jacob Wainwright, who afterwards acted so important a part in the home-bringing of his body. Thus attended, then, he started on August 25 for Lake Bangweolo, proceeding along the east side of Tanganyika, over rugged mountains which sorely tried the endurance of himself and his retinue, even though he had two donkeys to ride, a present from Mr. Stanley. His weakness soon found him out; ere he reached the shore of Tanganyika his old enemy dysentery seized upon him, and seems never wholly to have left him, but to have got worse and worse, causing him fearful suffering till the bitter end. In January 1873 the party got among the endless spongy jungle on the shores of Bangweolo, where vexatious delays took place, and where the journey was one constant wade below, and under an almost endless pour of rain from above. The Chambezi was crossed on March 26, and the doctor was getting worse and worse, losing great quantities of blood daily: but he seems never to have dreamed of turning back or of resting. No idea of danger seems to have occurred to him; he had so often before got over difficulties and attacks of all kinds, and he was so full of the object his heart was bent on, that the idea of death does not seem to have entered his head. This, we believe, moreover, is a characteristic of the disease. At last, in the middle of April, he was unwillingly compelled to allow his men to make a *kitanda*, or rude litter, in which he was borne to the end. Still the dreadful illness is spoken of as a mere annoying hindrance. Thus, on the 29th of April, Chitambo's village on the Lulimala, on the south of the lake, was reached. The last entry in the journal, of the last two pages of which a fac-simile is given, is April 27: "Knocked up quite, and remain—recover—sent to buy milch goats. We are on the banks of the Molilamo." On April 30 he was careful to wind his watch, but with the utmost difficulty, and early on the morning of May 1 he was found by the boys kneeling by the side of his bed, dead.

Chitambo behaved generously, and the men, headed by Chuma and Susi, acted with great intelligence, faithfulness, and discretion. Everything was carefully locked up, and the story of the preparation of Livingstone's body for the purpose of carrying it home to his own folk, by "beekin' forenen the sun," is known to all. After a five months' march through many difficulties, the attendants reached Unyanyembe. Here Lieutenants Cameron and Murphy and Dr. Dillon were met, and early this year the body arrived at Zanzibar, and in the end of April was deposited, as was meet, in Westminster Abbey.

A monument with an appropriate inscription has been erected to Livingstone in the Abbey; and doubtless, in time to come, a more suitable memorial will take the place of that rude one placed near the spot where their hero died, by the hands of his loyal and faithful attendants.

Mr. Waller, we think, has on the whole performed his sacred task judiciously, printing the journals, as we have said, exactly as he found them, though many of his parenthetical remarks seem to us unnecessary. The maps are of great assistance to the reader, and will be found of value to the geographer, although in the meantime, so far as Livingstone's last journey is concerned, they must be regarded as to a great extent conjectural. No doubt careful criticism will soon do its work both on journal and maps, and, with the help both of previous and subsequent exploration, test the exact geographical value of the achievements which cost Livingstone his life. The illustrations are interesting and helpful.

BUCHANAN ON THE CIRCULATION OF THE BLOOD

The Forces which carry on the Circulation of the Blood.
By Andrew Buchanan, M.D. Second Edition. (London: J. and A. Churchill, 1874.)

IN the same way that, among *a priori* mechanical philosophers, the possibility of discovering a perpetual motion was a favourite subject of discussion before the development of the theory of energy, so, among physiologists, the relative importance of the different forces which maintain the circulation of the blood was an equally common source of speculation before the introduction of the blood-pressure gauge and the sphygmograph. Within the last twelve or fifteen years, however, the various problems which used to occupy the attention of Magendie, Arnott, and Barry have been completely solved by entirely fresh methods of observation; and these, quite irrespective of their *opinions*, have verified or disproved their theoretical deductions according to whether or not they were based on sound premises.

Dr. Buchanan devotes much of the short work before us to the consideration of one of these bygone points, namely, the pneumatic forces which maintain the circulation of the blood, the importance of which he endeavours to demonstrate by a series of hydraulic experiments, the different elements of which are, we fear, slightly savoured with the bias of preconceived notions, as the result at which he arrives is that "after birth the circulation is mainly carried on by two forces—the propulsive force of the heart and the pressure of the atmosphere, acting nearly in the proportion of three of the former to two of the latter; but that as life advances, and the quantity of